FLAT CIRCUIT CONNECTOR WITH IMPROVED HOUSING

Field of the Invention:

This invention generally relates to the art of electrical connectors and, particularly, to a connector for terminating a flat circuit, such as a flat flexible circuit, a flexible printed circuit or other flat electrical cable.

Background of the Invention:

A wide variety of electrical connectors have been designed for terminating flat cables or circuits. A typical connector for flat circuits includes a dielectric housing molded of plastic material, for instance. The housing has an elongated opening or slot for receiving an end of the flat circuit which has generally parallel, laterally spaced conductors exposed across the end. A plurality of terminals are mounted in the housing and are spaced laterally along the slot, with contact portions of the terminals engageable with the laterally spaced conductors of the flat circuit. An actuator often is movably mounted on the housing for movement between a first position whereat the flat circuit is freely insertable into the slot and a second position whereat the actuator clamps the circuit in the housing and biases the circuit against the contact portions of the terminals.

FIGS. 7 and 8 herein show a prior art flat circuit connector of the character described above. The connector includes a housing, generally designated 20, having a plurality of terminals, generally designated 22, mounted in the housing from the rear thereof. The housing is mounted on a printed circuit board (not shown) and is fabricated of dielectric plastic material. The housing has a slot 20a at the front thereof for receiving an end of a flat circuit in a circuit insertion direction as indicated by arrow "B". The housing includes a rear portion 24b having a plurality of pairs of terminal-receiving passages 20c into which terminals 22 are mounted. Finally, the housing is elongated and includes a pair of walls or fixing arms 20d having fixing grooves 20e formed on the insides thereof. An elongated actuator, generally designated 24, is pivotally mounted on housing 20 by means of a pair of fixing protrusions 24a having pivot bosses 24b at opposite ends of the housing. The fixing protrusions are rotatably mounted in fixing grooves 20e formed inside arms 20d. A pair of locking protrusions 24c are formed at

opposite ends of the elongated actuator at the front thereof. The locking protrusions are hooked against the front of the housing when the actuator is in a closed position as shown in FIG. 7.

A pair of substantially enclosed fitting nails 26 are mounted over generally inverted T-shaped mounting portions 20f of the housing in the direction of arrows "B". The fitting nails are fabricated of metal material and are soldered to mounting pads on the printed circuit board to secure the connector to the board.

Actuator 24 is rotated 90° from its closed position shown in FIG. 7, to stand upright, and its rear end is inserted between fixing arms 20d of the housing. Fixing protrusions 24a are respectfully inserted into fixing grooves 20e inside arms 20d to fixed the actuator to the housing. This defines the open position of the actuator. While the actuator is in this open position, the end of the flat circuit is inserted into slot 20a in the direction of arrow "A". The actuator then is rotated about pivot bosses 24b to the closed position shown in FIG. 7 to bias appropriate contacts on the bottom of the flat circuit against terminals 22.

The present invention is directed to improvements in a housing for flat circuit connectors as described above.

Summary of the Invention:

An object, therefore, of the invention is to provide a new and improved electrical connector for terminating a flat electrical circuit.

In the exemplary embodiment of the invention, the connector includes an elongated dielectric housing having an opening for receiving an end of the flat circuit. A plurality of terminals are mounted on the housing in a side-by-side array and spaced along the opening. An elongated actuator is pivotally mounted on the housing for rotating movement between an open position allowing the flat circuit to be inserted into the opening and a closed position biasing the flat circuit against the terminals. The actuator includes rotating bosses at opposite longitudinal ends thereof and cam projections on end faces of the bosses. The housing includes an elongated rear portion into which the terminals can be mounted from the rear of the connector. A platform portion projects forwardly of the rear portion and combines therewith to define the opening into which the flat circuit can be inserted from the front of the connector onto the top of the platform. A pair of end walls are spaced outwardly from opposite longitudinal ends of the rear portion to define a pair of actuator-receiving slots for receiving the rotating bosses of the actuator. Cam

grooves are formed in the inside faces of the end walls for receiving the cam projections on the actuator.

According to one aspect of the invention, the terminals have contact arms with contact portions projecting into the opening for engaging appropriate contacts on the flat circuit. The housing includes a plurality of guide grooves on top of the platform portion for receiving the contact arms of the terminals. The housing has a plurality of partitions between the guide grooves. The partitions have sloped front end surfaces for guiding the flat circuit into the housing.

According to a further aspect of the invention, a pair of fitting nails are provided for fixing the connector to a printed circuit board. The end walls of the housing include nail-receiving passages opening at a front of the housing for inserting the fitting nails into the passages. The passages are in communication with the actuator-receiving slots, and the fitting nails include actuator supporting portions extending into the slots.

According to a further aspect of the invention, the actuator includes longitudinally outwardly projecting locking protrusions at opposite ends thereof. The end walls of the housing include locking grooves on the insides thereof for receiving the locking protrusions when the actuator is in its closed position.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

Brief Description of the Drawings:

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. 1 is a perspective view of a flat circuit connector according to the invention, with the actuator in its closed position;

FIG. 2 is an exploded perspective view of the connector;

FIG. 3 is a perspective view of the housing of the connector;

FIG. 4 is a top plan view of the housing;

FIG. 5 is an enlarged front-to-rear section through the connector, with the actuator in its closed position;

FIG. 6 is a fragmented perspective view, partially in section, of one end of the connector with the actuator in its open position; and

FIGS. 7 and 8 are views of the prior art connector described in the Background, above.

Detailed Description of the Preferred Embodiment:

Referring to the drawings in greater detail, and first to FIGS. 1 and 2, the invention is embodied in an electrical connector, generally designated 30, for connecting a flat electrical circuit 32 (not shown) to a printed circuit board (not shown). The flat electrical circuit may include flat cables or circuits, flat flexible cables, flexible printed circuits or the like.

Connector 10 includes a dielectric housing, generally designated 34, which is elongated and may be molded of plastic material. The housing defines a slot, generally designated 36, at the front end of the housing for receiving an end of the flat circuit in a circuit insertion direction as indicated by arrow "C" in FIG. 2. A plurality of conductive terminals, generally designated 38, are mounted in housing 34 in a side-by-side array and spaced along slot 36. Only the two end-most terminals are shown in FIG. 2. An actuator, generally designated 40, is pivotally mounted on housing 34 for movement between an open position (Fig. 6) allowing the flat circuit to be inserted into slot 36 and a closed position (Fig. 5) biasing the flat circuit against the terminals, as will be seen hereinafter. The terminals are inserted into the rear of the housing in the direction of arrows "D" and a pair of fitting nails, generally designated 42, are inserted into the front of the housing in the direction of arrows "E".

Referring to FIG. 5 in conjunction with FIG. 2, terminals 38 are inserted into terminal-receiving passages 43 in housing 34. Each terminal includes a generally horizontally oriented, U-shaped configuration defined by a base, 38a, an upper pivot arm 38b and a lower contact arm 38c. The upper pivot arm has a pivot groove 38d formed in the underside thereof near the distal end thereof. The contact arm has a contact portion 38e at the distal end thereof projecting into the circuit-receiving slot 36. A foot 38f projects downwardly from base 38a and is disposed generally flush with the bottom of housing 34 for connection to an appropriate circuit trace on the printed circuit board. The terminals are stamped and formed of conductive sheet metal material.

Referring to FIGS. 3 and 4 in conjunction with FIGS. 1 and 2, housing 34 is elongated and includes an upstanding rear portion 34a and a bottom, forwardly projecting platform portion 34b whereby the circuit-receiving slot 36 is open in an upward and forward direction. A plurality of generally parallel guide grooves 44 are spaced along platform portion 34b between a plurality of partitions 44a. When terminals 38 are inserted into the housing, contact arms 38c are guided into grooves 44, with the contact portions 38e projecting upwardly into the circuit-receiving slot 36. Partitions 44a have sloped surfaces on the tops thereof and the ends thereof for guiding the flat circuit into opening 36.

A pair of end walls 34c are formed integrally with housing 34. Fitting nails 42 are inserted in the direction of arrows "E" into a pair of inverted L-shaped nail-receiving passages 46 formed in the pair of end walls and opening at the front of the housing. An upwardly opening actuator-receiving slot 48 is formed in each end wall 34c at the rear thereof behind and in communication with the respective nail-receiving passage 46. A rotating cam groove or recess 50 is formed inside each end wall 34c within slot 48. The cam-receiving groove 50 includes a first cam groove or recess 50a and a second cam groove or recess 50b above the first groove, for purposes described hereinafter. A locking groove 52 is formed on the inside of each end wall 34c above the respective nail-receiving passage 46.

Actuator 40 is elongated and includes an elongated pressure plate 40a along the front thereof and an elongated pivot shaft 40b along the rear thereof spaced from the pressure plate. The actuator is a one-piece structure, and pivot shaft 40b is connected to pressure plate 40a by a plurality of supports 54 at spaced intervals along the length of the actuator, and defining spaces 56 between the supports. A rounded pressing portion 40c is formed at the bottom rear corner of the actuator.

Actuator 40 further includes a block-like support boss 58 at each opposite end thereof. A rotating cam 60 projects outwardly from the outer surface of boss 58. Boss 58 has a support 58a and a movement prevention portion 58b, for purposes described hereinafter. Pressure plate 40a of actuator 40 includes a cut-out 62 at each corner thereof. Finally, a locking protrusion 64 projects outwardly from each opposite end of pressure plate 40a.

Each fitting nail 42 includes an L-shaped mounting portion 42a defined by a vertical or upright support plate 42b and a horizontal support plate 42c. The L-shaped mounting portion is insertable into the respective L-shaped passage 46 at the front of the respective end wall 34c of

the housing. The fitting nail has a horizontal fixing plate or foot 42d at the bottom thereof and which will be generally flush with housing 34 for connection, as by soldering, to a mounting pad on the printed circuit board to fix the connector to the board. An open-sided hole 42e is formed in the outer edge of fixing plate 42d for receiving a fixing member (not shown) to further fix the connector to the board. According to the invention, each fitting nail 42 includes a biasing portion or elevating arm 42f in the form of a vertical plate for biasing actuator 40 upwardly and securely seat pivot shaft 40b of the actuator into pivot grooves 38d of terminals 38. In essence, plate 42f vertically supports the actuator, particularly in its closed position.

FIG. 6 shows actuator 40 in an upright or open position so that an end of a flat circuit can be inserted freely into slot 36. It can be seen that support boss 58 of the actuator is positioned within the actuator-receiving slot 48 in end wall 34c of the housing. Cam projection 60 is located in cam groove 50b. After the flat circuit is inserted into space 36, actuator 40 is pivoted downwardly to its closed position shown in FIG. 5. It can be seen that pivot shaft 40b is seated in pivot grooves 38d in the underside of pivot arms 38b of terminals 38. In this position, pressure plate 40a of the actuator will press the flat circuit against contact portions 38e of contact arms 38c of the terminals. When the actuator is rotated to its closed position, locking projection 64 snaps into locking groove 52 (see Fig. 2) in the inside of end wall 34c.

Actuator 40 is assembled to housing 34 by orienting the actuator in an upright position and moving the actuator downwardly. During assembly, cam projections 60 snap into cam grooves 50a in the inside surfaces of end walls 34c. To that end, the outer surfaces of cam projections 60 are tapered, and the longitudinal distance between the outer extremities of cam projections 60 is slightly larger than the distance between the inside surfaces of end walls 34c so that the end walls spread outwardly due to their own elasticity, and the end walls move back inwardly to their normal condition once cam projections 60 "snap" into first cam grooves 50a.

Terminals 38 are assembled into passages 43 in housing 34 by first pivoting actuator 40 to its closed position as shown in FIG. 5. The terminals are inserted into the passages in the direction of arrow "D" until the terminals are firmly seated as shown in FIG. 5. Pivot arms 38b of the terminals are located in spaces 56 between supports 54 of the actuator. Contact arms 38c of the terminals extend into guide grooves 44 between partitions 44a on top of platform portion 34b of housing 34.

When the fitting nails are fully inserted into the housing, biasing portions or plates 42f of the fitting nails form elevating cams which engage the bottom of actuator 40 to bias the actuator upwardly. The effect of this upwardly biasing motion of the actuator moves pivot shaft 40b of the actuator into pivot grooves 38d of terminals 38 to rigidly secure the actuator in the connector and to allow for positive pivoting of the actuator relative to the housing. In addition, cam projections 60 (Fig. 2) will move from first cam grooves 50a to second cam grooves 50b.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

CLAIMS:

What is claimed is:

1. An electrical connector for terminating a flat electrical circuit, comprising:

an elongated dielectric housing having an opening for receiving an end of the flat circuit;

a plurality of terminals mounted on the housing in a side-by-side array and spaced along the opening;

an elongated actuator pivotally mounted on the housing for rotating movement between an open position allowing the flat circuit to be inserted into said opening and a closed position biasing the flat circuit against the terminals, the actuator having rotating bosses at opposite longitudinal ends thereof and cam projections on end faces of the bosses; and

said housing including

an elongated rear portion into which the terminals can be mounted from the rear of the connector,

a platform portion projecting forwardly of the rear portion and combining therewith to define said opening into which the flat circuit can be inserted from the front of the connector onto the top of the platform,

a pair of end walls spaced outwardly from opposite longitudinal ends of the rear portion to define a pair of actuator-receiving slots for receiving the rotating bosses of the actuator, and

cam grooves in the inside faces of the end walls for receiving the cam projections on the actuator.

2. The electrical connector of claim 1 wherein said terminals have contact arms with contact portions projecting into said opening for engaging appropriate contacts on the flat circuit, and said housing includes a plurality of guide grooves on top of the platform portion for receiving the contact arms of the terminals.

3. The electrical connector of claim 2 wherein said housing includes a plurality of partitions between the guide grooves, the partitions having sloped front end surfaces for guiding the flat circuit into said opening.

4. The electrical connector of claim 1, including a pair of fitting nails for fixing the connector to a printed circuit board, and said pair of end walls of the housing include nail-receiving passages opening at a front of the housing for inserting the fitting nails into the passages.

5. The electrical connector of claim 4 wherein said nail-receiving passages are in communication with said actuator-receiving slots, and the fitting nails include actuator supporting portions extending into the slots.

6. The electrical connector of claim 1 wherein said actuator includes longitudinally outwardly projecting locking protrusions at opposite ends thereof, and said pair of end walls of the housing include locking grooves on the insides thereof for receiving the locking protrusions when the actuator is in its closed position.

7. An electrical connector for terminating a flat electrical circuit, comprising:

an elongated dielectric housing having an opening for receiving an end of the flat circuit;

a plurality of terminals mounted on the housing in a side-by-side array and spaced along the opening, said terminals having contact arms with contact portions projecting into said opening for engaging appropriate contacts on the flat circuit;

an elongated actuator pivotally mounted on the housing for rotating movement between an open position allowing the flat circuit to be inserted into said opening and a closed position biasing the flat circuit against the terminals, the actuator having rotating bosses at opposite longitudinal ends thereof and cam projections on end faces of the bosses;

a pair of fitting nails for fixing the connector to a printed circuit board; and

said housing including

an elongated rear portion into which the terminals can be mounted from the rear of the connector,

a platform portion projecting forwardly of the rear portion and combining therewith to define said opening into which the flat circuit can be inserted from the front of the connector onto the top of the platform,

a pair of end walls spaced outwardly from opposite longitudinal ends of the rear portion to define a pair of actuator-receiving slots for receiving the rotating bosses of the actuator,

cam grooves in the inside faces of the end walls for receiving the cam projections on the actuator,

a plurality of guide grooves on top of the platform portion for receiving the contact arms of the terminals, and

said pair of end walls including nail-receiving passages opening at a front of the housing for inserting the fitting nails into the passages.

8. The electrical connector of claim 7 wherein said housing includes a plurality of partitions between the guide grooves, the partitions having sloped front end surfaces for guiding the flat circuit into said opening.

9. The electrical connector of claim 7 wherein said nail-receiving passages are in communication with said actuator-receiving slots, and the fitting nails include actuator supporting portions extending into the slots.

10. The electrical connector of claim 7 wherein said actuator includes longitudinally outwardly projecting locking protrusions at opposite ends thereof, and said pair of end walls of the housing include locking grooves on the insides thereof for receiving the locking protrusions when the actuator is in its closed position.